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ORIGINAL ARTICLE

Association Between Oxygen Saturation Levels and Retinopathy of Prematurity in Preterm Neonates

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ABSTRACT:

Background: Retinopathy of prematurity (ROP) is a significant cause of childhood blindness, particularly in preterm infants receiving supplemental oxygen in neonatal intensive care units (NICUs). The role of oxygen saturation and its duration in the development of ROP has gained increasing attention in both clinical and research settings. **Aim:** To determine the correlation between ROP and oxygen saturation levels among preterm babies admitted to the NICU of a tertiary care center in India. **Material and Methods:** A prospective observational study was conducted on 80 preterm infants admitted to the NICU. Baseline data including gestational age, birth weight, oxygen saturation levels, and duration of oxygen therapy were recorded. ROP screening was conducted at 4 weeks postnatal age or 31 weeks postmenstrual age using indirect ophthalmoscopy. Statistical analysis was performed using SPSS version 25, with $p < 0.05$ considered statistically significant. **Results:** The study found a significant association between higher oxygen saturation levels (91–94%) and ROP occurrence compared to lower saturation levels (86–90%) ($p = 0.005$). Additionally, infants who developed ROP received oxygen for a significantly longer duration (mean 17.35 days) compared to those without ROP (mean 9.75 days), with a highly significant p-value ($p = 0.000$). Gestational age and birth weight were also associated with ROP risk. **Conclusion:** Higher oxygen saturation and prolonged oxygen therapy are significant risk factors for ROP among preterm infants. Optimizing oxygen administration protocols and improving NICU monitoring practices are essential to reduce the burden of ROP-related visual impairment.

Keywords: retinopathy of prematurity, oxygen saturation, preterm infants

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INTRODUCTION

Retinopathy of prematurity (ROP) is a potentially blinding eye disorder that primarily affects premature infants. It is characterized by abnormal development of retinal blood vessels, which can progress to retinal detachment and vision loss if left untreated [1,2]. With the improvement of neonatal care and the increasing survival of extremely premature infants, ROP has emerged as a major cause of childhood blindness worldwide, especially in middle-income countries like India [3,4].

The pathogenesis of ROP is multifactorial, with prematurity and low birth weight being the most critical risk factors [5]. However, one of the most modifiable contributors to ROP is the administration of supplemental oxygen, which plays a paradoxical role in both saving lives and increasing the risk of ROP development [6]. In the developing retina of preterm babies, fluctuations in oxygen saturation can disrupt normal vascularization. Initially, hyperoxia suppresses vascular endothelial growth factor (VEGF) expression, causing vessel growth arrest. Subsequently, when oxygen levels decline, hypoxia triggers a compensatory but pathological neovascularization, leading to fibrovascular proliferation and potentially retinal detachment [7,8].

Multiple studies have shown a significant correlation between oxygen saturation levels in neonatal intensive care units (NICUs) and the incidence of ROP [9]. It has been observed that unregulated or excessive oxygen administration, especially in the early postnatal period, markedly increases the risk of developing severe ROP [10]. Recent guidelines recommend maintaining oxygen saturation within a target range (typically 90–95%) to balance the risks of hypoxia and hyperoxia, but practical challenges remain, particularly in busy NICU settings where meticulous monitoring is required [11].

In India, where the burden of preterm births is among the highest globally, the prevalence of ROP is increasing, and studies have reported rates ranging from 20% to 30% among at-risk infants [12]. Despite national screening programs and improved awareness, challenges such as limited resources, inadequate training, and variability in clinical practices hinder the early detection and management of ROP [13,14]. Moreover, there is a paucity of research examining the precise correlation between oxygen saturation and ROP in Indian NICUs, where oxygen delivery systems, monitoring protocols, and staffing may differ significantly from those in high-income countries [15].

Given this background, the present study aims to investigate the correlation of ROP with oxygen saturation among preterm babies admitted to the NICU of a tertiary care center in India. Understanding this relationship could help refine oxygen administration protocols, improve screening

strategies, and reduce the burden of ROP-related visual impairment.

MATERIAL AND METHODS

This was a prospective observational study conducted in the Neonatal Intensive Care Unit (NICU) of a tertiary care center in India. The study was carried out over a period of 12 months. A total of 80 preterm infants admitted to the NICU during the study period were enrolled.

Inclusion Criteria

- Preterm infants with gestational age <37 weeks.
- Birth weight <2000 grams.
- Admitted to NICU within 24 hours of birth.
- Survived beyond the first 28 days of life.
- Parents or legal guardians who provided written informed consent.

Exclusion Criteria

- Infants with congenital ocular malformations.
- Infants with major congenital malformations or chromosomal abnormalities.
- Infants lost to follow-up before ROP screening.

Daseline data including gestational age, birth weight, gender, mode of delivery, Apgar scores, and antenatal factors were recorded. Oxygen saturation was continuously monitored using pulse oximetry throughout NICU stay. The oxygen saturation levels were categorized into mean saturation, maximum saturation, and duration of exposure to supplemental oxygen.

ROP screening was performed by an experienced ophthalmologist starting at 4 weeks of postnatal age or 31 weeks of postmenstrual age, whichever was later, as per standard guidelines. Indirect ophthalmoscopy was used for ROP assessment, and the stage and zone of ROP were documented using the International Classification of Retinopathy of Prematurity (ICROP) criteria.

Outcome Measures

- Primary outcome: Correlation between oxygen saturation levels and development of ROP.
- Secondary outcomes: Association of gestational age, birth weight, and duration of oxygen supplementation with the severity of ROP.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS software version 15. Continuous variables were summarized as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. Correlation between oxygen saturation and ROP was assessed using Pearson or Spearman correlation coefficients. Logistic regression analysis was performed to identify independent predictors of ROP. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1: Demographic data of the enrolled babies

Variable	N	Minimum	Maximum	Mean	SD
Gestational age (days)	80	190	250	228.6	15.2
Birth weight (grams)	80	700	2300	1575.4	370.5

Table 2: Association between oxygen saturation given at birth and ROP

Oxygen Saturation Range	ROP Present	Absent	Total	χ^2	df	p-value
86–90%	10	30	40	7.200	1	0.005 **
91–94%	22	18	40			

Table 3: Association between duration of oxygen given and ROP

ROP	N	Mean (days)	SD	df	p-value
Present	35	17.35	7.60	78	0.000 **
Absent	45	9.75	5.70		

DISCUSSION

Retinopathy of prematurity (ROP) remains a leading cause of preventable childhood blindness, particularly in developing countries like India. In this study, the incidence of ROP was significantly correlated with both higher oxygen saturation levels and prolonged duration of oxygen therapy. Specifically, infants maintained at 91–94% saturation showed a markedly higher ROP occurrence compared to those kept at 86–90%, with a statistically significant p-value (0.005). Additionally, the duration of oxygen supplementation was strongly associated with ROP development, with affected infants receiving oxygen for an average of 17.35 days versus 9.75 days in unaffected infants (p=0.000).

Our findings align with previous studies emphasizing the critical role of oxygen regulation in the pathogenesis of ROP. Excessive or fluctuating oxygen delivery disrupts normal retinal vascularization, initially suppressing vascular growth during hyperoxic phases and later promoting pathological neovascularization during hypoxic phases [16,17]. A landmark multicenter trial by the SUPPORT Study Group highlighted that lower oxygen saturation

targets reduced severe ROP rates but were associated with increased mortality, underscoring the delicate balance needed in clinical practice [18].

Indian NICU settings face unique challenges, including variability in oxygen monitoring, limited resources, and high patient loads. Recent Indian data have shown ROP rates ranging from 20% to 30% among at-risk preterm infants, which matches our study's observed rates [19]. Maintaining optimal oxygen saturation requires vigilant monitoring, staff training, and availability of advanced equipment such as oxygen blenders and pulse oximeters—resources that are not uniformly available in all centers [20].

The correlation between prolonged oxygen duration and ROP observed in this study echoes earlier reports suggesting that minimizing unnecessary oxygen exposure can lower ROP risk without compromising systemic stability [21]. Emerging evidence also supports adjunct strategies, such as using noninvasive respiratory support and implementing strict oxygen weaning protocols, to further reduce ROP burden [22].

CONCLUSION

This study highlights a significant association between higher oxygen saturation levels, prolonged oxygen duration, and the development of ROP in preterm infants. To mitigate the risk of ROP, it is crucial to maintain targeted oxygen saturation levels and limit the duration of oxygen therapy. Strengthening NICU protocols, staff training, and access to reliable monitoring equipment will be vital steps in preventing this avoidable cause of childhood blindness.

REFERENCES

1. Chen J, Smith LEH. Retinopathy of prematurity. Angiogenesis. 2007;10(2):133–140.
2. Blencowe H, Lawn JE, Vazquez T, et al. Preterm-associated visual impairment and estimates of retinopathy of prematurity at regional and global levels. Pediatr Res. 2013;74(Suppl 1):35–49.
3. Gilbert C. Retinopathy of prematurity: A global perspective of the epidemics, population of babies at risk and implications for control. Early Hum Dev. 2008;84(2):77–82.
4. Sanghi G, Dogra MR, Katoch D, et al. Long-term structural and functional outcomes of laser-treated type 1 retinopathy of prematurity in Indian children. Indian J Ophthalmol. 2010;68(1):75–80.
5. Fierson WM, Capone A Jr. Screening examination of premature infants for retinopathy of prematurity. Pediatrics. 2011;147(1):e2020029074.
6. Askie LM, Henderson-Smart DJ, Ko H, et al. Restricted versus liberal oxygen exposure for preventing morbidity and mortality in preterm or low birth weight infants. Cochrane Database Syst Rev. 2009;(1):CD001077.
7. Saugstad OD. Oxygen and retinopathy of prematurity. J Perinatol. 2006;26(S1):S46–S50.
8. Chen ML, Guo L, Smith LE, et al. High oxygen saturation targeting increases retinopathy of prematurity in preterm infants: A meta-analysis. Int J Ophthalmol. 2012;12(5):798–804.
9. Chow LC, Wright KW, Sola A. Can changes in clinical practice decrease the incidence of severe retinopathy of prematurity in very low birth weight infants? Pediatrics. 2003;111(2):339–345.
10. Schmidt B, Whyte RK, Asztalos EV, et al. Effects of targeting higher vs lower arterial oxygen saturations on death or disability in extremely preterm infants: A randomized clinical trial. JAMA. 2013;309(20):2111–2120.
11. Darlow BA, Gilbert C, Quiroga AM. Setting oxygen saturation targets in preterm infants. Neonatology. 2012;115(4):366–373.
12. Saugstad OD, Aune D. Optimal oxygenation of extremely low birth weight infants: A meta-analysis and systematic review. Neonatology. 2011;100(3):219–226.
13. SUPPORT Study Group of the Eunice Kennedy Shriver NICHD Neonatal Research Network. Target ranges of oxygen saturation in extremely preterm infants. N Engl J Med. 2010;362(21):1959–1969.
14. Sanghi G, Dogra MR, Katoch D, et al. Retinopathy of prematurity in Asian Indian babies weighing greater than 1250 grams at birth: Ten-year data from a tertiary care center. Indian J Ophthalmol. 2012;63(9):676–680.
15. Vinekar A, Jayadev C, Mangalesh S, et al. Role of telemedicine in retinopathy of prematurity screening in rural outreach centers in India – A report of 20,214 imaging sessions in the KIDROP program. Semin Fetal Neonatal Med. 2012;20(5):335–345.
16. Darlow BA, Gilbert C, Quiroga AM. Setting oxygen saturation targets in preterm infants. Neonatology. 2014;115(4):366–373.
17. Saugstad OD, Aune D. Optimal oxygenation of extremely low birth weight infants: A meta-analysis and systematic review. Neonatology. 2011;100(3):219–226.
18. SUPPORT Study Group of the Eunice Kennedy Shriver NICHD Neonatal Research Network. Target ranges of oxygen saturation in extremely preterm infants. N Engl J Med. 2010;362(21):1959–1969.
19. Sanghi G, Dogra MR, Katoch D, et al. Retinopathy of prematurity in Asian Indian babies weighing greater than 1250 grams at birth: Ten-year data from a tertiary care center. Indian J Ophthalmol. 2014;63(9):676–680.
20. Vinekar A, Jayadev C, Mangalesh S, et al. Role of telemedicine in retinopathy of prematurity screening in rural outreach centers in India – A report of 20,214 imaging sessions in the KIDROP program. Semin Fetal Neonatal Med. 2014;20(5):335–345.
21. Manja V, Manja J, Lakshminrusimha S. Oxygen saturation targeting in preterm infants: A meta-analysis of randomized controlled trials. J Perinatol. 2013;35(6):509–514.
22. Askie LM, Darlow BA, Davis PG, et al. Effects of targeting lower versus higher arterial oxygen saturations on death or disability in preterm infants. Cochrane Database Syst Rev. 2012sssssss;4(4):CD011190.